

dated 04-05-2004 ment 26.04.2004

DESCPAMD

EP03763715.4 PCTEP.03.07217

WO 2004/007158

PCT/EP2003/007217

ART 34 AMDT

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# DEVICE AND METHOD OF LIQUID-PERMEABLE PERFORATION OF A NONWOVEN

The present invention relates to a method of manufacturing a perforated nonwoven, perforation means, particularly needles, engaging in the nonwoven. The needles are positioned on a first roller, the needles engaging through the nonwoven in a surface of a second roller. Furthermore, a roll calender for perforating a nonwoven is provided, the roll calender having a first roller and a second roller. The first roller has perforation means. A perforated nonwoven material is also described, which is produced using a method and/or a roll calender.

~~Calenders which each have a needle roller and a perforated roller are described in European Patent Application 1 048 419 A1 and in European Patent Application 1 046 479 A1. The needles of the needle roller engage in the corresponding diametrically opposite openings of the perforated roller and are thus capable of perforating material guided through the gap formed by the perforated roller and the needle roller. Materials which may be perforated are to be plastic films, paper, or nonwoven materials. The latter are to be able to be up to a few millimeters thick.~~

The object of the present invention is to provide a method and a device which allow the technical outlay for manufacturing perforated nonwoven to be kept low, but simultaneously allow high production speed.

This object is achieved by a method of manufacturing a perforated nonwoven having the features of Claim 1 and by a roll calender for perforating a nonwoven having the features of Claim 10. Further advantageous embodiments are specified in the ~~particular subclaims.~~

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EP 0 598 970 A1 discloses a device and a method for producing a perforated web, for example, a membrane material. In the process, the web advances between two counterrotating cylinders, of which a first cylinder is smooth and a second cylinder is provided with projections. The second cylinder rotates at a greater peripheral speed than the peripheral speed of the smooth cylinder. The smooth cylinder comprises an elastically yielding covering of a rubber material or textile fibers. The different peripheral speeds of the cylinders produce a slipping action, which creates in the web holes and forms around them strands of partially detached material. These strands extend in the direction, in which the membrane material passes between the two cylinders. The function of the strands consists in allowing liquid to pass from the one side of the membrane to the other, and preventing the liquid from flowing back in the opposite direction.

EP 0 214 608 A2 describes perforated spunbonded nonwovens of polypropylene fibers and bicomponent fibers. In this connection, it discloses a method of perforating a nonwoven, wherein a positive roller mounts a plurality of perforation needles, which are brought into contact with a counter roller. The nonwoven is perforated in that the perforation needles enter the cavities of the counter roller and in so doing penetrate the nonwoven. The nonwoven has perforations with diameters ranging from 0.015 to 0.125 of an inch. However, only 20% to 55% of the entire surface is perforated.

WO9967454 discloses a method for producing from fibers a nonwoven material with a plurality of perforated hole structures extending over the cross section of the nonwoven.

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The perforated hole structures are produced by laying the fibers on a screen belt to a fibrous web, by subsequently  
 5 perforating the fibrous web in a perforation mechanism, and converting it into a nonwoven in a bonding unit. To this end, the perforation mechanism comprises two elements. One element possesses a plurality of spikes directing toward the fibrous web. The second element possesses openings, into which the  
 10 spikes of the first element immerse in part, and displace without damage the fibers of the fibrous web while passing therethrough, thereby forming the hole structures. The openings of the second element connect to a source of overpressure and vacuum, which permits taking into the openings  
 15 or blowing out therefrom fibers that are in the region of the openings. Nonwovens produced therefrom have hole structures with a diameter from 0.5 mm to 5 mm and 40 to 120 bonding points per square centimeter, with the bonding surface being 10% to 40% of the surface of the nonwoven material.

20 WO03004229 discloses a nonwoven fabric perforating device according to Figures 1 and 2 and the description of the Figures at pages 11 and 12. The device comprises a perforating roller 4 with needles and a counter roller 5. The counter roller 5  
 25 includes a coating 14, preferably a rubber coating. The needles of the perforating roller are able to penetrate the coating of the counter roller, preferably to a depth from 2.5 mm to 6 mm. Likewise, the coating 14 itself may contain holes that are arranged in facing relationship with the  
 30 needles 11.

WO03004259 discloses a perforating device, wherein a first roller with a positive structure engages a second roller with a negative structure and perforates a nonwoven in this process.

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For example, a counter roller 3 shown in Figure 1 comprises, preferably on its surface, openings 14 that extend into the counter roller 3. In their dimensions, the openings 14 approximately correspond to the projections 5 of the perforating roll 2. The openings may be circular holes, elongate holes, or, however, also channels, as result, for example, from forming ridges on the surface of the counter roller 3. A thermoplastic structure 7 is formed by the interaction of the perforating roller 2 and the counter roller 3.

dated 04-05-2004

ment 26.04.2004

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EP03763715.4- PCTEP 03 07217

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~~DEVICE AND METHOD OF LIQUID-PERMEABLE PERFORATION OF A NONWOVEN~~

~~The present invention relates to a method of manufacturing a perforated nonwoven; perforation means, particularly needles, engaging in the nonwoven. The needles are positioned on a first roller, the needles engaging through the nonwoven in a surface of a second roller. Furthermore, a roll calender for perforating a nonwoven is provided, the roll calender having a first roller and a second roller. The first roller has perforation means. A perforated nonwoven material is also described, which is produced using a method and/or a roll calender.~~

Calenders which each have a needle roller and a perforated roller are described in European Patent Application 1 048 419 A1 and in European Patent Application 1 046 479 A1. The needles of the needle roller engage in the corresponding diametrically opposite openings of the perforated roller and are thus capable of perforating material guided through the gap formed by the perforated roller and the needle roller. Materials which may be perforated are to be plastic films, paper, or nonwoven materials. The latter are to be able to be up to a few millimeters thick.

The object of the present invention is to provide a method and a device which allow the technical outlay for manufacturing perforated nonwoven to be kept low, but simultaneously allow high production speed.

This object is achieved by a method of manufacturing a perforated nonwoven having the features of Claim 1 and by a roll calender for perforating a nonwoven having the features of Claim 10. Further advantageous embodiments are specified in the particular subclaims.

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A method according to the present invention for manufacturing a perforated nonwoven provides that perforation means, particularly needles, engage in the nonwoven. The needles are positioned on a roller, the needles engaging through the nonwoven into a surface of a second roller. The needles displace fibers of the nonwoven, the needles engaging in a material. The material is selected in such a way that the needles may displace the material. In particular, the needles may displace the material in such a way that contours form in the material. The needles preferably engage reproducibly in these contours. The contours are particularly first formed by the engaging of the perforation means. The perforation means preferably at least partially engage in fibrous material which preferably forms at least apart of a surface of the second roller. The displaceable material is particularly a felt material.

According to a refinement, the perforation means are needles. The needles may have differing geometries and cross-sections. For example, the needles may be pointed or blunt, may have undercuts, and may be cylindrical or conical. The geometry and the cross-section may change over the length of the needle. In addition to needles, pyramids, stumps, particularly conical stumps, mushroom geometries, oblong geometries having heads, at least partially round heads, for example, may be used. The perforation means may be milled, etched, or even eroded from the solid. The perforation means may also be incorporated later, for example, glued, clamped, or in another form-fitting and/or frictional way.

The perforation means, particularly needles, preferably engage in felt material which forms the surface of the second roller. In this way, because the felt material is positioned on the second roller, the felt material forms a counterpart diametrically opposite the needles, which preferably may have an elastic behaviour, but also has a certain hardness. The felt

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material is preferably capable of stabilizing the nonwoven on the second roller, so that the roller may laterally displace nonwoven fibers as it slides into the nonwoven.

5 According to one embodiment, the felt material which is used on the second roller is positioned on the second roller while standing under mechanical tension. This particularly offers a certain strength of the felt material in relation to a pressure exerted by the needles and/or the first roller. Felt fibers are  
10 also capable in this way of having a certain elastic behaviour.

According to one embodiment of the method, the first roller, having the needles, is driven, while the second roller which has the felt material on the surface is not driven directly.  
15 Rather, a movement of the first roller ensures that the second roller is carried along by the engagement of the needles in the nonwoven material. In this way, the first roller and the second roller run synchronously with one another. The felt material is preferably selected in such a way that when the needles engage  
20 in the felt material, this always occurs at approximately the same points. Openings are thus formed within the felt material in which the needles always engage. In this way, wear of the felt material when it is used on the second roller is restricted.

25

According to a further embodiment, the needles are heated. The heating is preferably to a temperature which lies below a melting temperature of the nonwoven or a decomposition temperature of the felt material. For example, a needle surface  
30 temperature may be such that fibers of the nonwoven are melted and/or softened, without, however, the fiber structure as such being destroyed. A refinement of the method provides that the felt material is applied to the second roller as a shrinkage hose. This shrinkage hose is preferably seamless. The second  
35 roller preferably has a metal surface. It may be smooth on its surface or have a corrugation. The corrugation is, for example,

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applied as a spiral or in the form of grooves with their axes parallel. There is also the possibility that the surface of the second roller has screw-like grooves with a left or right pitch. The particularly metal surface of the second roller and the felt material are preferably connected in that the hose exerts a pressure on the metal surface of the second roller. Furthermore, an adhesive may also be applied between the felt material and the metal surface. This adhesive may preferably be dissolved again through the effect of alcohol or something similar, for example. In this way, the connection between the film material and the second roller may be removed again. If the felt material is too worn, it is replaced with a new felt material. The remaining parts of the second roller do not absolutely have to be replaced.

A refinement, which also represents an independent idea, provides that the felt material is applied to a carrier. The felt material having the carrier is then subsequently applied to the roller, pulled on, for example. The carrier is preferably a changeover bobbin. The changeover bobbin is preferably pushed onto the roller. The changeover bobbin and the roller are connected via typical connections, which are particularly frictional and/or form-fitting. For example, tongue and groove systems, screw connections, or something similar may be used. The felt material is preferably applied replaceably to the carrier, so that the carrier is reusable. The carrier, in particular the changeover bobbin, allows rapid felt material replacement. A standstill time of the calender is thus minimized. The felt material and the carrier are connected, for example, as was described above in the context of the connection of the felt material to the roller. A plastic material is preferably used for the changeover bobbin. A shrinkage hose only has to be pulled onto the changeover bobbin. The rollers of the calender may remain unchanged. By using multiple changeover bobbins, even shorter useful lives of the felt material may be overcome rapidly. Through a sufficient

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supply, replacement of the changeover bobbin may be performed simultaneously with a replacement of a roll from the unwinder.

According to a further and also independent idea of the present invention, the roll calender is constructed in such a way that the counter roller may be made accessible on one side in such a way that, for example, a changeover bobbin may be replaced. This is preferably performed while the other side remains in its position, in a bearing, for example. If the weight of the counter roller must be compensated for, a support may be provided on the calender for this purpose. The support absorbs the weight which would otherwise be produced by unclamping the now free side of the counter roller. The support is preferably at least partially movable so that there is sufficient protection as the changeover bobbin is pulled off and on. A part of the support is particularly movable along the axis of the counter roller. According to a refinement, the counter roller is supported on the free side by an attachable weight receiver. The weight receiver is screwed on, for example, and extends along the axis of the counter roller. The force receiver is particularly long enough that the sleeve may be pushed on and off.

A further, also independent idea provides that the calender has a roller changer for the counter roller. If, for example, a first felt material is worn so much that it must be replaced, the first counter roller having the first felt material is moved away from the perforation roller and a second counter roller of the calender having a second felt material is brought into contact with the perforation roller. The first counter roller may now, for example, be uninstalled in order to replace the first felt material. For example, a roller changer for a calender is disclosed in German Patent 100 05 306 C1, to which reference is made in its entirety in the scope of this disclosure, particularly in regard to the calender, the roller replacement, and the operation of the roller.

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A good pressure during the use of a felt hose results, for example, if the felt hose is pulled over the cleaned surface of the second roller or the cleaned carrier and subsequently is  
5 wetted through with water heated to approximately 60 - 80 °C. In this case, it may be advantageous to add an additional wetting agent to the water, this may be a detergent, for example. In this way, shrinkage of the felt hose is accelerated. Subsequently, the felt hose is quenched using cold  
10 water and dried on the second roller at a temperature of 30 - 40 °C, for example. The connection between the felt material and the second roller and/or carrier achieved in this way is sufficient that there is no slip between the felt material and the second roller as the needles penetrate into the felt  
15 material.

A surface of the felt material itself may also be processed. This is necessary, for example, if the felt material surface has elevations or appearances of wear, which cause  
20 interference. There is also the possibility of either roughening the surface or processing it in such a way that its degree of roughness decreases. The latter may be performed, for example, using light singeing of protruding felt material fibers and subsequent removal using a brush, for example.

25 A felt material which has wool as a fibrous material is preferably used. For certain applications, however, it may also be advisable to use other fibrous materials as the felt material. These may be, for example, flax or cotton, viscose,  
30 polyamide, polyacrylonitrile, polyester, polypropylene, aramid, polytetrafluoroethylene, polyamide, or polyphenylene sulfide. While wool has a long-term heat resistance of around 100 °C, at a higher needle temperature, polyamide, polyester, or aramid fibers are used, for example. Special durability of the  
35 shrinkage hose used has resulted when it has a hardness of group F according to DIN 61 200. The felt material preferably

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has a gross density between 0.32 and 0.48 g/cm<sup>3</sup>. The felt material preferably has a felt thickness which is greater than 5 mm, particularly greater than 8 mm, preferably 10 mm and more, for example, up to 15 mm. A felt hose is preferably used  
5 which has a wool felt according to F 2 having a wall thickness of approximately 10 mm and a density of 0.36 g/cm<sup>3</sup>.

Use of a felt hose and/or a felt material has the further advantage that little consideration must be taken of  
10 temperature expansion of the needle and/or of the first roller. Particularly if the first roller carries along the second roller, the needles and the engagement points in the felt material are automatically synchronized. Furthermore, an embodiment provides that the material of the second roller has  
15 a lower elasticity than the felt material which forms the surface of the second roller. The second roller is preferably manufactured from a metal, particularly an alloyed steel. Another embodiment provides that the second roller has plastic, and preferably is made predominantly of plastic. Furthermore,  
20 the second roller may also be a hollow roller.

A gap between the first and the second roller is preferably set in such a way that the needles which penetrate into the nonwoven displace the fibers of the nonwoven and press against  
25 the felt material, the fibers being compressed and an opening in the nonwoven being stabilized. Depending on the speed of the rollers and/or the nonwoven guided through them, the pressure applied, the temperature, and other parameters, there is the possibility that the openings will assume a funnel shape, for  
30 example. Furthermore, the use of a felt material on the second roller allows the use of greatly differing needle geometries. These may be pointed, conical, blunt, or shaped in other ways. Their cross-sections may be rectangular, star-shaped, round, semicircular, figure-shaped, or even mixtures of all of these.

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According to a refinement, the needles are particularly shaped in such a way that as the needles engage, fibers are at least partially displaced out of the nonwoven. In this case, the fibers form a structure which deforms corresponding to a geometry of the needles. The structure preferably arises from a nonwoven surface after the nonwoven passes through the first and the second roller. Another embodiment of the method provides that upon penetration of the needles into the felt material, fibers are at least partially also pulled into the felt material. As the nonwoven is subsequently pulled off of the second roller, this may lead to the existing texturing of the nonwoven surface becoming more pronounced. For example, by adhering in the felt, the fibers may be pulled out until the felt-fiber connection is broken.

According to a further idea of the present invention, a roll calender for perforating a nonwoven is provided, the roll calender having a first and a second roller. The first roller has perforation means which project from a surface of the first roller. The first and the second roller form a gap, through which a nonwoven to be perforated is guided. The second roller has a felt material as a surface, the gap between the first and the second roller being set in such a way that the perforation means engage in the felt material. A refinement provides that the gap between the first and second roller is changeable. In particular, it may be set in such a way that the needles used do not engage completely in the felt material and the nonwoven guided through, but only up to a certain range.

The needle roller preferably has a circular needle shape. A needle diameter preferably has a value between 1 and approximately 3 mm. A needle area is particularly between 1.5 and 5 mm<sup>2</sup>, a needle density is preferably between 8 and 25 per cm<sup>2</sup>, a needle area component preferably being between 30 % to 70 %. An insertion depth of the needles into the felt material is preferably between 2 mm to 6 mm. The gap between the first

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and the second roller is preferably set in such a way that the needles are not inserted completely into the felt material and into the nonwoven. A further embodiment provides that the gap has a size such that a nonwoven guided between them is compressed simultaneously with the perforation. For example, the nonwoven may be subjected to a pressure and/or a temperature for this purpose, which is exerted by the first roller or parts thereof on the nonwoven.

10 Data of an exemplary needle roller, using which various nonwovens were perforated on the second roller in interaction with a felt material, are listed in the following table.

Needle shape in top view	Needle diameter [mm]	Needle area [mm <sup>2</sup> ]	Needles [number/cm <sup>2</sup> ]	Needle area proportion [%]
Circular	1.95	2.987	15.36	45.86

15 Exemplary measurement data of various experiments which were determined using a needle roller and a felt-coated counter roller are listed in the following table:

Feed material	A	A	A	B	B	B	B
Area weight [g/mm <sup>2</sup> ]	30	30	30	30	30	40	40
Needle insertion depth [mm]	4.5	4.5	5.0	4.5	5.0	4.5	5.0
Hole area [mm <sup>2</sup> ]	0.63	0.68	1.09	0.73	0.84	0.91	0.95
Open area [%]	9.7	10.6	18.3	12.3	14.2	15.1	15.7

20 A: polypropylene spunbonded nonwoven

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B: polypropylene spunbonded nonwoven +  
polyethylene/polypropylene bi-component spunbonded nonwoven  
In the experiments shown, the screen belt speed was 95  
m/minutes.

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The perforation means, particularly the needles, are preferably implemented in such a way that the nonwoven is perforated so it is permeable to liquid. It has been shown to be particularly suitable in this case to use a prebonded nonwoven as the nonwoven used. A single-layer nonwoven is preferably used. For example, a spunbonded nonwoven made predominantly of polypropylene is used, which is single-layer. This spunbonded nonwoven preferably has a weight between 20 g/m<sup>2</sup> and 40 g/m<sup>2</sup>. The basic weight is preferably around 30 g/m<sup>2</sup>. A prebonded nonwoven has, for example, a bonded area in the form of thermobonding of 14.49 %. The nonwoven preferably has a bonded area between 10 % and approximately 60 %. Besides thermobonding, the nonwoven may also obtain its stability and strength through other bonding methods, for example, through water jet bonding, adhesive, adhesive fibers, ultrasound welding, etc. The hole sizes which were produced, for example, were 1.09 mm<sup>2</sup> as hole area, an average length being 1.35 mm in MD and an average length in CD being 1.04 mm. The needle roller used was heated from the inside using a thermal oil for this purpose, a surface temperature of the needle roller being set between 105 °C and 130 °C. Using the single-layer nonwoven, hole sizes were achieved which had an axis ratio MD to CD of approximately 1. Speeds of up to 95 m/minutes were used in this case.

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Further experiments were performed, for example, on a two-layer nonwoven. A first layer was made of a spunbonded nonwoven made of polypropylene, a second layer was made of a bi-component material. The two-layer nonwoven was prebonded and had a bonding area of approximately 17 %. Especially good, stable

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circular perforations resulted for a base weight which was between 30 and 40 g/m<sup>2</sup>.

5 A prebonded nonwoven which has a bonding area which is particularly between 8 % and 25 % is preferably used for perforation.

10 Besides the materials polypropylene and polyethylene cited, the nonwovens may also have other materials, for example, polyamides, polyester, glass fibers, PET, viscose, acetate, polyacrylics, polystyrene, polyvinyl chloride, their copolymers, and mixtures thereof. The use of bi-component or multicomponent nonwovens made of these materials in particular is also possible.

15 Further advantageous embodiment and refinements may be inferred from the following drawing. The features illustrated there may be combined with the embodiment of the present invention described above into further independent refinements, without  
20 the present invention being restricted as such in its embodiment by the drawing.

Figure 1 shows a first device for manufacturing a perforated nonwoven,

25 Figure 2 shows a detail from Figure 1,

Figure 3 shows a single-layer nonwoven before perforation,

30 Figure 4 shows the single-layer nonwoven from Figure 3 after perforation,

Figure 5 shows a two-layer nonwoven before perforation,

35 Figure 6 shows the two-layer nonwoven from Figure 5 after perforation,

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Figure 7 shows a material, particularly a felt material, on a changeover bobbin,

5 Figure 8 shows a schematic view of a roll calender, in which a roller in which the perforation means may engage is laterally accessible to replace a surface material, and

10 Figure 9 shows a schematic view of a further roll calender, in which a replacement of rollers is possible.

Figure 1 shows a first device 1 for manufacturing a perforated nonwoven 2. A prebonded nonwoven 3 is guided from an unwinder 4  
15 over various web guides 5 and a tension measuring roller 6 to a roll calender 7. The roll calender 7 has a first roller 8 having needles 9 as perforation means and a second roller 10. The second roller 10 is preferably manufactured from metal and has a felt material 11 on its surface. The felt material 11 is  
20 preferably a shrinkage hose 12. The shrinkage hose 12 is pushed over the second roller 10, so that an inner surface 13 of the shrinkage hose 12 is in contact with a metal surface 14 of the second roller 10. The surface 15 of the shrinkage hose 12 therefore simultaneously forms an outer surface of the second  
25 roller 10. The needles 9 of the first roller 8 engage in this surface 15. The prebonded nonwoven 3 is now guided to the roll calender 7 in such a way that it first comes to rest on the second roller 10. The prebonded nonwoven 3 preferably has a looping angle around the second roller 10 of more than 90°, particularly more than 120°, and preferably more than 180°. This allows tensions in the nonwoven to be reduced due to the settling on the felt material 11 up to the perforation by the needles 9. In particular, the not yet perforated nonwoven 3 may be smoothed in this way. A defined tension is preferably  
30 exerted on the nonwoven. The tension is, for example, at least

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detectable via the tension measuring roller 6, and preferably also adjustable via a position regulator.

It may also be seen from Figure 1 that a gap 16 between the  
5 first roller 8 and the second roller 10 is adjustable. At least one of the two rollers 8, 10 may have its position changed. In this way, a perforation depth of the needles 9 in the felt material 11 is adjustable. An adjustment of the perforation depth is checked, for example, directly following the  
10 perforation by checking the perforation image of the perforated nonwoven 2. This may particularly be performed automatically. For example, a quality may be checked immediately via a detection unit, preferably a camera and preselectable parameters, and appropriate adjustments may be undertaken in  
15 the event of deviations. For example, it may additionally be indicated when the felt material must be replaced. After the unperforated nonwoven 3 is perforated by the needles 9, according to a further independent idea, the perforated nonwoven is not immediately drawn out of the gap 16 and wound  
20 using a winder. Rather, the nonwoven remains on the first roller 8 and is guided further according to the rotation direction indicated by the arrow. The perforated nonwoven 2 is preferably guided along over a looping angle of greater than 90°, particularly greater than 120°, and preferably in a range  
25 from 160° to 270°. Only subsequently is the perforated nonwoven 2 pulled off of the first roller 8 and therefore the needles 9. Guiding the nonwoven in this way provides many advantages: firstly, the needles may be heated sufficiently that the perforations in the nonwoven stabilize. In this case,  
30 stabilization may be performed through a more uniform, particularly also slower supply of heat to the nonwoven fibers surrounding the needles 9. This makes it possible, for example, to soften not only nonwoven fibers which are directly in contact with the needles 9. Rather, a larger wrap angle  
35 preferably also allows nonwoven fibers positioned neighboring thereto to be at least softened. Softening preferably leads to

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slight adhesion of the surfaces of fibers pressing against one another. In this way, structures and geometries assumed may be stabilized. In addition, nonwoven guiding of this type allows the nonwoven fibers to be compressed against one another through the engagement of the needles 9 in the perforated nonwoven 2 and the further guiding of the nonwoven on the surface of the felt material 11. This also leads to stabilization of the perforation structure generated in the nonwoven by the needles 9. The perforated nonwoven 2 is guided from the first roller 8 to a second tension measuring roller 17. From there, the perforated nonwoven 2 reaches a winder 18 via web guides 5. The tension measuring roller 17 allows the stresses applied to the nonwoven to be checked repeatedly during the perforation procedure and the speed of the winder 18 and/or unwinder 4 to be adjusted accordingly. Furthermore, the speed of the first roller 8 and/or the second roller 10 may be regulated in such a way that a desired tensile stress acts on the nonwoven.

Figure 2 shows a detail from Figure 1. The engagement of the needles 9 in the felt material 11 of the shrinkage hose 12 may be seen. An exemplary construction of the first roller 8 is schematically indicated. The needles 9 are introduced into the surface of the first roller 8. The possibilities of the constructive achievement of the object of providing needles or other perforation means in the first roller 8 are known in the related art. For example, reference is made in the scope of this disclosure to the documents in the related art cited above.

Figure 3 shows a single-layer nonwoven 19, which is shown perforated in Figure 4. The single-layer nonwoven 19 is preferably a spunbonded nonwoven. The perforations are particularly implemented in such a way that the nonwoven fibers projecting from the surface form funnel-shaped structures.

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Figure 5 and Figure 6 show a two-layer nonwoven 20, which is either laminated together before the perforation or is laminated together by the perforation procedure. A first layer 21 and a second layer 22 are perforated simultaneously. A  
5 formation of funnel-shaped structures of the first layer 21 preferably extends in this case into the second layer 22 in such a way that the latter has an approximately smooth surface without further elevations. Depending on the penetration depth of the needles, however, nonwoven fibers from the first layer  
10 21 and/or the second layer 22 may also arise from a surface of the two-layer nonwoven 20.

Figure 7 shows a changeover bobbin 23, which is preferably manufactured from plastic. A shrinkage hose is applied to the  
15 changeover bobbin, for example, which particularly has a felt material 11. The felt material 11 may be removed again from the changeover bobbin 23, so that subsequently a new shrinkage hose may again be placed on the changeover bobbin 23. Preferably, the changeover bobbin 23 has a certain elasticity and/or  
20 deformability. For example, in this way a pressure which acts on the changeover bobbin 23 from the shrinkage hose may act from the changeover bobbin 23 on a counter roller of the calendar positioned diametrically opposite a perforation roller. In particular, the pressure may be so great that in  
25 this way an attachment of the changeover bobbin 23 on the counter roller is at least supported.

Figure 8 shows a schematic drawing of a calender 24, which is laterally accessible. This allows replacement of a surface on  
30 the second roller 10 without the second roller 10 having to be uninstalled. A holder 25 and/or cover may be folded out laterally for this purpose or displaced upward and/or downward. This allows free lateral access to the second roller 10. In particular, the roller construction of the second roller 10 and  
35 a corresponding dimensioning and weight layout may be such that a holder on one side in the calender 24 is sufficient to catch

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the weight of the second roller 10. This may apply if the calender 24 is not in operation, but also if the calender 24 is in operation. For example, the second roller 10 may be a hollow roller, may be made of light material, and/or may be at least partially made of plastic or even aluminium. Using the ability to clamp on only one side, the second roller 10 may also be pulled out of the calender frame and the surface of the second roller 10 may be changed.

The construction and mode of operation of the schematic drawing shown in Figure 9 corresponds to that of the arrangement known from Figure 1. In addition, a principle is illustrated in Figure 9, with which the second roller 10 may be replaced by a third roller 26 through a replacement mechanism. In this way, for example, the second roller 10 may be replaced while the third roller 26 is engaged with the first roller 8. For this purpose, the roll calender 7 has, in addition to the third roller 26, a lever mechanism 27, for example, via which the second roller 10 and the third roller 26 are connected to one another. If the lever mechanism 27 is moved as indicated by the arrows around an axis (not shown in greater detail), for example, the second roller 10 moves away from the first roller 8. The third roller 26, in contrast, is moved toward the first roller 8. Fine adjustment of the distance of the particular roller 10, 26 to the first roller 8 may preferably be performed independently of the lever mechanism 27. If the third roller 26 is engaged with the first roller 8, the nonwoven to be perforated may be guided along the third roller 26 to the first roller 8 as indicated by the dashed lines. The tension measuring roller 17 may preferably have its position tailored to that of the third roller 26. In this way is ensured that tension measurement occurs even during operation of the third roller 26.